

Don't forget the salty soup: Calculations for bulk marine geochemistry and radionuclide geochronology

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In reference to marine sediments I would like to add to the theme of this session: "Your data are only as good as your standards and methods!" if you remember to correct your analytical data for pore water salt.

Performing sophisticated analytics in marine geochemistry constantly aims at improving the detection limits as well as minimizing the margin of error regarding the precision and accuracy of the method. However, this holds true only if you are genuinely aware of what are you actually analyzing. The normal procedure of sample preparation for marine sediments consists of drying and grinding. Thereafter, these samples are analyzed with regards to their elementary or mineral concentrations. In the best case scenario, sampled water content data are available for calculations of physical properties, such as porosity and dry bulk density, which are both absolutely necessary for the calculation of elementary flux or geochemical budgets. In addition, based on the water content (w , in % of the wet weight) and a normal salinity of 3.5‰ (or 35 PSU), the amount of salt (s in mass%) in the dry sample can be determined by:

1. Calculating the mass percentage of the salty pore water (w') as: $w' = w \cdot 100 / 96.5$
2. Calculate the salt as: $s = 100 \cdot (w' - w) / (100 - w)$.

This is especially important for samples with water contents above 50% ($s=3.6\%$; $w=80\%$ $s=14.5\%$), which are very common in the biogenic opal-rich, diatomaceous sediments of the Southern Ocean around Antarctica. These calculations could be improved by using known salinities, obtained through chlorine determinations, of samples or pore water directly.

Although these calculations are simple, they are often ignored, giving rise to two potential errors, sometimes greater than 14% (relative concentration). The first, greatest and often neglected mistake is a "wrong" net weight - the input is not the pure sediment but sediment + salt. For most ratios of elements, the salt content is irrelevant, but every calculation of concentrations must be corrected accordingly, also radiogenic activity calculations (e.g. ^{210}Pb , ^{230}Th). Geochemists try to avoid the second error by using a salt correction when subtracting the salt related element concentrations directly from the composition analyzed.